

Vegetative propagation of *Aesculus indica* through stem cuttings treated with plant growth regulators

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Abstract: Cuttage propagation of *Aesculus indica* was tested by treatments with different concentrations of indole-3-acetic acid (IAA) @ 2000, 4000 (ppm), indolebutyric acid (IBA) @ 2000, 4000 (ppm) and naphthlctic acid (NAA) @ 2000, 4000 (ppm) in dry formulation in the Forest Nursery, Faculty of Forestry, SKUAST-K, Shalimar. The cuttings treated with IBA @ 4000 ppm and IBA @ 2000 ppm had a sprouting rate of 75% and 50%, respectively, which was significantly higher than that of control and other treatments. The highest rooting rate (50%) was recorded in the cuttings with the application of IBA @ 4000 ppm. The cuttings treated with IBA @ 2000 ppm had 25% rooting rate. All other treatments along with control (talc powder) failed to induce rooting. It was concluded that IBA @ 4000 ppm was a better-applied concentration for vegetative propagation of *A. indica* under Kashmir conditions.

Keywords: *Aesculus indica*; indolebutyric acid; rooting; stem cuttings; vegetative propagation

Introduction

Aesculus indica Colebr is a deciduous spreading tree species, grown in Northwestern Himalaya at an altitude of 3 600 m above sea level. It is a fast growing tree species that can reach a height of 30 m and a girth of 3 m, and is most often used for reforestation purpose. *A. indica* is an important associate of many coniferous tree species like Spruce, Silver fir, Deodar, etc.

The rooted plants by cottage have many advantages, such as faster growth rate (Ooyamma and Toyoshima 1965), greater stock stand uniformity, better site matching, and true-to-type planting material production (Fielding 1969). Cuttings can be categorized into three groups as easy to root, difficult to root and obstinate to root (Nanda 1970). Cuttings of poplars and willows can root easily even without use of growth regulators (Guha 1973), while pines are considered to be obstinate to root (Deuber 1942; Allsop 1950).

In vegetative propagation, to treat cuttings with growth hormone has become an effective measure in mass propagation of desired genotypes. However, *A. indica* is not commonly propagated through vegetative means because it is hard to root. To treat the cuttings with auxin or other plant growth regulators

(PGRs) can promote root sprouting and is helpful to cell multiplication and elongation of root. Mishra et al. (2003) studied the vegetative propagation of *Quercus leucotrichophora* through stem cuttings by using different PGRs in dry formulation. Stimulatory effect of growth regulators on root formation have been reported by various researchers in many forest species like *Eucalyptus* (Wilson 1993) and *Taxus baccata* (Khali & Sharma 2003). Cuttings of *Ulmus wallichiana* (Elm) gave 27% of rooting rate when treated with indole-3-acetic acid (IAA) or indolebutyric acid (IBA) (Bhat et al. 2007). Thakur and Gupta (1998) treated the cutting of *A. nitida* with different concentrations of IBA and obtained the highest root percentage at IBA 800 ppm.

In the present study, the stem cuttings of *A. indica* were treated by plant growth regulators, IAA, IBA and naphthlctic acid (NAA). The aim of this study was to test the potential effect of PGRs on the cuttings and to select an optimal concentration of PGR for stem cutting of *A. indica*.

Materials and methods

The study was conducted at the Forest Nursery, Faculty of Forestry, SKUAST-K, Shalimar (74.89°E and 34.08°N, about 1 587 m above sea level) in 2007. The study area belongs to temperate climate, with a severe winter extending from December to next March. Soil type is silty loam. Annual precipitation is in range of 676–1 193 mm, with an average of 944.6 mm. The temperature ranges from the minimum of -8.0°C in winter to the maximum of 33°C in summer.

The cuttings of *A. indica* were treated with different concentrations of IAA @ 2000, 4000 (ppm), IBA @ 2000, 4000 (ppm) and NAA @ 2000, 4000 (ppm) in dry formulation to determine the effect of different plant growth regulators on root initiation.

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Simple talc powder was used as control.

Stem cuttings with uniform size (22 cm in length and 1.5–2 cm in thickness) were collected in February 2007 from different trees, buried in soil, and taken out until the 1st week of March 2007. A ringed cut was made at 1.5–2 cm above the basal end of the stem cuttings in order to induce callusing and subsequent root formation. In total 224 cuttings were used in the experiment and 32 cuttings were used for each treatment. The treatments were prepared in dry formulation by mixing the PGRs in talc powder. The cuttings were soaked in distilled water for 3–5 min, dipped in talc powder containing PGRs, and then were planted in polybags (12.5 cm x 17.5 cm) containing sand as rooting medium. A hole in the sand in polybags was made by a stick to prevent detachment of PGRs mixed talc powder from the cuttings. The polybags were taken care with respect to watering and weeds. The experiment lasted for one full growing season from March 2007 to Sep. 2007. Shoot height and root length were measured by scale (ruler CGS) and the collar diameter was measured by digital calliper in the last week of September. Sprouting percentage, rooting percentage, survival percentage, height (cm), collar diameter (cm) and root length (cm) were recorded.

Results and discussion

Different sprouting rates were obtained for the cuttings treated with different plant growth regulators (Table 1 and 2) (Fig. 1 and 2). The cuttings treated with IBA @ 4000 ppm and IBA @ 2000 ppm had a sprouting rate of 75% and 50%, respectively, which was significantly higher than that of control; whereas, the cuttings treated with other treatments only had 25% sprouting rate (as the same as control), indicating that the IAA and NAA are not effective in enhancing bud sprouting in cutting.

Table 1. Effects of plant growth regulators in dry formulations on sprouting, rooting and survival of hardwood cuttings of *Aesculus indica* Colebr.

| Treatment (growth hormones) | Sprouting (%) | Rooting (%) | Survival (rooted cuttings) [%] |
|--------------------------------|------------------|----------------|--------------------------------------|
| Control (Talc powder) | 25.00 (26.25) | 0.00 | 0.00 |
| IAA (2000 ppm) | 25.00 (26.25) | 0.00 | 0.00 |
| IAA (4000 ppm) | 25.00 (26.25) | 0.00 | 0.00 |
| IBA (2000 ppm) | 50.00 (45.00) | 25 (26.25) | 100.00 (90.00) |
| IBA (4000 ppm) | 75.00 (60.00) | 50.00 (45.00) | 100.00 (90.00) |
| NAA (2000 ppm) | 25.00 (26.25) | 0.00 | 0.00 |
| NAA (4000 ppm) | 25.00 (26.25) | 0.00 | 0.00 |
| CD _(0.05) | N.S | 10.49 | 25.02 |

Figures in parenthesis are arc sine transformations. C.D (0.05) is critical difference at 95 per cent confidence interval. N.S means not significant. IAA, indole-3-acetic acid; IBA, indolebutyric acid; NAA, naphthlactic acid

Rooting of the cuttings occurred with the application of IBA. The highest rooting rate (50%) was recorded in the cuttings with the application of IBA @ 4000 ppm. The cuttings treated with IBA @ 2000 ppm had 25% rooting rate. All other treatments

along with control (talc powder) failed to induce rooting. The results revealed that the PGRs namely IAA and NAA are not effective in inducing rooting in the cuttings. The average height of shoot, average collar diameter and average root length in case of rooted cuttings with IBA @ 4000 ppm were recorded as 16.73 cm, 0.41 cm and 17.80 cm, respectively. In case of rooted cuttings with IBA @ 2000 ppm, the average height of shoot, average collar diameter and average root length were 16.68 cm, 0.40 cm and 16.90 cm, respectively (Table 2). The results thus confirmed that all the parameters of the cuttings treated with IBA @ 4000 ppm were higher than those of other treatments along with control.

Table 2. Effects of plant growth regulators in dry formulation on height, collar diameter and root length of hardwood cuttings of *Aesculus indica* Colebr

| Treatment (growth hormones) | Average height (cm) | Average collar diameter (cm) | Average root length (cm) |
|--------------------------------|------------------------|---------------------------------|-----------------------------|
| Control (Talc powder) | 0.00 | 0.00 | 0.00 |
| IAA (2000 ppm) | 0.00 | 0.00 | 0.00 |
| IAA (4000 ppm) | 0.00 | 0.00 | 0.00 |
| IBA (2000 ppm) | 16.68 | 0.40 | 16.90 |
| IBA (4000 ppm) | 16.73 | 0.41 | 17.80 |
| NAA (2000 ppm) | 0.00 | 0.00 | 0.00 |
| NAA (4000 ppm) | 0.00 | 0.00 | 0.00 |
| CD _(0.05) | 4.72 | 0.14 | 4.91 |



Fig. 1 Rooted stem cuttings of *Aesculus indica* Colebr in polybags after PGR treatments



Fig. 2 Rooted stem cuttings of *Aesculus indica* Colebr after PGR treatments

Our study proved that IBA @ 4000 ppm is an optimal plant growth regulator for cutting rooting of *A. indica*. This result is in accordance with other studies. Shamet et al. (1989) obtain 80% rooting rate of *Celtis australis* cuttings treated with 3000 ppm IBA. A previous study by Sharma & Pandey (1999) showed that application with 5000 ppm of IBA had a very high rooting rate of 89.30% in *Dalbergia sisso* (Sisso) and 76.43% in *Dalbergia latifolia* (Indian rose wood).

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